Cranes, Crosswalks, and Big Gulps

For use with: Arizona Wildlife Views Television Show, 07-08 Season, Episode 3

Careers; Nature of Science; Technology **Time Frame:** 2-3 hours **Grade:** 4-8

Overview:
This video takes a look at three common jobs in the wildlife biology field. Even though all of the jobs allow the individual to work with animals, they each require a slightly different skill set. Students should see that wildlife biology is more than just "playing with animals." This lesson will focus on the creative nature of science.

Essential Questions
- How do biologists manage wildlife populations?
- What place does creativity have in science?

Objectives
- Explain the impact that GPS technology has made on wildlife biology.
- Use common materials to design a unique solution to an experimental problem.

Arizona Department of Education Standards

Science

4th grade	5th grade	6th grade	7th grade	8th grade
S2-C1-PO2	S3-C1-PO1	S2-C1-PO2	S2-C1-PO2	S2-C1-PO4
S3-C2-PO2	S3-C2-PO2	S2-C1-PO4	S2-C1-PO4	S3-C2-PO1
		S3-C2-PO1	S3-C2-PO1	S3-C1-PO2
		S3-C2-PO2	S3-C2-PO2	
		S3-C2-PO4	S3-C2-PO4	

Reading

4th grade	5th grade	6th grade	7th grade	8th grade
S3-C1-PO1	S3-C1-PO1	S3-C1-PO2	S3-C1-PO2	S3-C1-PO2
			S3-C1-PO11	S3-C1-PO11

Materials and Resources
- Copy of Arizona Wildlife Views episode
- "Leasing the Rattlesnake" article – 1 per student

Teacher Preparation
- Acquire a copy of the television show. You can check local listings to determine when it will air and record it directly. You may also check the Department's web site to see if a copy can be downloaded or ordered.
- Write the vocabulary words and questions on the board.
- Photocopy the *Science News* article titled "Leashing the Rattlesnake."

Background Information:
This is not a lesson plan in the traditional sense. It does not provide step-by-step directions for completing an activity. Instead, it provides information to help you use an episode of the *Arizona Wildlife Views* television program in your classroom. It contains four suggested activities along with extensions and modifications. The first activity focuses on vocabulary. We have provided and defined some of the words used in the video. You are encouraged to use any appropriate strategies to introduce these to your students. Then, there is a series of comprehension questions that

students can answer while watching the video. Answers (directly from the video) are provided in italics. Next, the critical thinking questions build on the major concepts introduced in the video. Students need to put a little bit more thought into these questions. Some reasonable answers are provided in italics. However, teachers should be cautious and realize that students may provide additional answers that can be supported with evidence. Finally, there is an in-depth activity. This activity allows students to evaluate and synthesize one or more of the concepts from the video, perhaps applying it to a new context or utilizing additional skills.

This episode originally aired on PBS (KAET Channel 8) in Phoenix on February 3, 2008. It may also be shown on regional PBS stations or other channels. For additional viewing information or download options, please visit **http://www.azgfd.gov/focuswild**.

Additional information about the topics featured in this episode can be found at:

- ✓ Highway Crossings: http://www.azgfd.gov/w_c/research_why_elk_cross.shtml
- ✓ Arizona's Wildlife Linkages: http://www.azdot.gov/Highways/OES/AZ_Wildlife_Linkages/
- ✓ Black-footed Ferrets: http://www.azgfd.gov/w_c/blackfooted_ferret.shtml
- ✓ Avian Influenza: http://www.azgfd.gov/artman/publish/article_431.shtml
- ✓ Other wildlife diseases: http://www.azgfd.gov/w_c/wildlife_related_diseases.shtml
- ✓ Sandhill cranes: http://www.azgfd.gov/h_f/game_crane.shtml

In addition, an entire unit focusing on the Highway 260 underpasses has been developed. You can download these lessons at: **http://www.azgfd.gov/i_e/ee/lessons/elk/elk.shtml**.

Relevant Vocabulary:

- Anterior – toward the front
- Captive Breeding – capturing wild animals, breeding them in zoos and other facilities, in order to release them back to the wild
- Habitat Fragmentation – breaking large habitat areas into small, isolated pieces
- Mitigation – action taken to reduce or eliminate the negative impacts of hazards or disasters
- Nocturnal – active at night
- Pandemic – a disease that has spread through a large area such as a country, a continent, or the world
- Permeable – able to pass through or across
- Posterior – toward the back
- Reintroduction – bringing species back to some of their original range

Comprehension Questions:

1. Why is the Wildlife Linkages Map important? *Answer: It identifies 152 spots in Arizona that are important to animal movement and migration. This will help government officials better plan growth and development in order to minimize the impact to wildlife.*
2. Where was the last colony of wild black-footed ferrets discovered? How many ferrets were there? *Answer: Wyoming. 18.*
3. How many black-footed ferret reintroduction sites have been identified? *Answer: 8.*
4. Why is the ferret spotlighting program important? *Answer: It allows biologists to record the number and location of ferrets in the wild.*
5. Why do the researchers use the Big Gulp cups? *Answer: To plug the other holes in the burrow in order to force the ferret into the trap.*
6. What is the main source of food for black-footed ferrets? *Answer: Prairie dogs.*
7. What is H5N1? *Answer: The scientific designation for the virus more commonly called "Bird Flu."*
8. How many cases of Avian Influenza have occurred in the United States? *Answer: Zero.*
9. How often does Avian Influenza spread from one person to another person? *Answer: Very rarely.*

Critical Thinking Questions:

1. How has GPS technology improved wildlife biology? *Answer: Prior to the development of GPS technology, wildlife tracking was a very time-consuming and cumbersome project. Captured animals had to be marked (perhaps with ear tags) and then released. New data could not be gathered on this animal unless it died, was recaptured, or observed in the wild. GPS has allowed biologist to gather more data. GPS collars that are fitted on captured (and released) animals can now collect location data for that particular animal at any time the biologist wishes. This allows the researchers to get more complete information about animal movements and behavior patterns.*
2. How are elk crosswalks similar and different to human crosswalks? *Answer: Both crosswalks are designed to help individuals cross a street while reducing the risk to themselves, the vehicles, and the people in the vehicles. While human crosswalks typically require a person to push a button or activate the light in some other manner, the elk crosswalks are programmed to detect when an elk has approached the road. At that time, the lights and warning signs are triggered on both sides of the road, warning drivers of a potential elk crossing. Drivers are not required to stop but should proceed through the area with caution at a slower rate of speed.*
3. The video mentioned that the sandhill crane is a major target species for monitoring Avian Influenza. Why is this species a good candidate for spreading this disease? *Answer: During the summer breeding season, the cranes are spread among many locations where they may interact with other bird species from around the world. During migration, the cranes tend to join together at a few locations, increasing the chance of passing any disease to others.*

In-Depth Activity: Creative Science

The black-footed ferret and the wildlife corridors programs are excellent examples of scientists "thinking outside the box." For the ferrets, scientists had to develop an inexpensive way to prevent the animals from leaving their burrow. The solution: Big Gulp cups blocking the holes. For the wildlife corridors, scientists needed a new and effective way to reduce tragic accidents between vehicles and elk. The solution: an electronic crosswalk that detects elk and warns drivers. Both were complex problems that required the biologists to come up with creative solutions. These are, of course, just two examples of many situations in science where the researchers need to use a little creativity.

Pretend you are a scientist studying snakes and frogs. Your research requires some very unique equipment. However, you do not have a lot of money and the equipment has never been developed.

How would you create:

- o a leash for a rattlesnake?
- o a blindfold for a rattlesnake?
- o Earplugs for a bullfrog?

For each of the tasks above, describe the challenges with creating the equipment and what you would do.

After you have come up with your ideas, read the article titled "Leashing the Rattlesnake" provided by your teacher. In what ways, were the solutions that the scientists developed similar and different to your solution? Based on what you read, do you think your solutions would work?

Differentiated Instruction:

Extensions:

- **Geography:** Sandhill cranes are migratory, breeding during the summers in the northern United States and Canada and wintering in the southern United States and Mexico. A common breeding ground for cranes is the Yukon Delta National Wildlife Refuge, where the Yukon and Kuskokwim Rivers meet the Bering Sea in Alaska. Some of these birds then migrate to the Sulphur Springs Valley in southeastern Arizona. One of the best wintering grounds is the Whitewater Draw Wildlife Area, just northeast of Bisbee. On the way to Arizona, they often need to stop to gain some energy to continue their long journey. One common location is the National Audubon Society's Rowe Sanctuary, in Nebraska, just east of Kearney along the Platte River. Locate and mark these three areas on a United States map. Measure the travel distance from the summer and winter grounds. Sandhill cranes can travel between 300 and 400 miles per day. Determine the number of days the birds need to fly if they are migrating along this route.
- **Language Arts:** Sometimes, in order to save a species, it is necessary to remove all remaining members of that species from the wild and place them in captive breeding programs. This was the case with the black- footed ferrets. Determine the pros and cons for this management strategy. Do you agree with this action? Write a persuasive essay in which you support your viewpoint.
- **Mathematics:** The video mentioned that the estimated population in the state in 2050 will be 17 million people. Research current and historical Arizona populations. Create a graph showing the population growth through time. If possible, compare this graph with growth in other states or the country.

Modifications:

- Create a student handout with the vocabulary words and questions already provided.
- Provide students with the definitions and have them match them to the appropriate vocabulary words.
- Provide fill-in-the-blank responses for the Comprehension Questions, allowing students to listen for appropriate words to complete the sentences.
- Download the video transcripts and provide to students.

Reflection:

Use the space below to reflect on the success of the lesson. What worked? What didn't? These notes can be used to help the next time you teach the lesson. In addition, the Department would appreciate any feedback. Please visit **http://www.azgfd.gov/focuswild** and submit a lesson evaluation.

Leashing the Rattlesnake

A behind-the-scenes look at experimental design

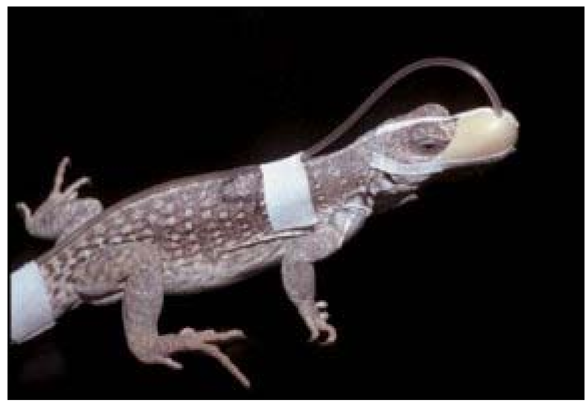
By Susan Milius

Science News; Sept. 27, 2003; Vol. 164, No. 13; pp. 200-202

Depending on how you look at them, snakes have no neck or nothing but neck, and either way, Ron Swaisgood had a problem. To finish his Ph.D. at the University of California, Davis he had to figure out how to put a rattlesnake on a leash. Obviously, dropping a slipknot around the snake's neck wouldn't do. Swaisgood's research project required that the snake comfortably slither, coil, and strike but still be tethered tightly enough that there was no chance it could escape.

Swaisgood eventually developed a great snake leash, finished his degree, and proceeded to his current job at the San Diego Zoo. The scientific paper based on the research just says he tethered the snake and then goes on to describe the ways that ground squirrels assess snakes as threats *(Science News: 10/9/99, p. 237)*. The leash joined thousands of other little unsung triumphs of creativity in experimental design that don't usually show up in scientific articles – or reports in *Science News*. Ask for the details, though, and another side of research appears. Here, many biologists say, is a lot of the fun.

Experimental science demands creativity in solving problems great and small, and the study of animal behavior makes a dramatic showcase for the process. Animals clearly have minds of their own, and to elucidate such foreign perspectives, researchers have to design cleverly, from the basic strategy of the experiment to dozens of lesser details. The traditions of animal behavior celebrate do-it-yourself flair, and experiments mix the sublimely high tech with the ridiculously simple. Consider the snake leash.



JOGGER MASK. Desert iguanas wouldn't wear the helmets designed for monitoring other lizards' oxygen consumption. So, Stephen Adolph of Harvey Mudd College in Claremont, Calif., and Todd Gleeson and Tom Hancock, both currently with the University of Colorado at Boulder, turned to laboratory cousins of eyedropper bulbs. With scissors, they tailored them to fit a desert iguana snout and fastened them on with strips of athletic tape. "They look like clown noses," Adolph recalls, but the iguanas don't seem to mind.
Photograph courtesy of Steve Adolph

Swaisgood reminisces that the first Northern Pacific rattlesnake he'd caught for his experiment "was kind of a phlegmatic snake." The university veterinary surgeons who frequently prepare animals for experiments gave the rattler an implant of a little plastic loop. Swaisgood then just clipped a line to the loop and staked the snake in place.

The next snake, however, had a completely different personality and moved vigorously. A loop implant didn't look like a good idea. "We were concerned he might hurt himself," Swaisgood says. "We started going through our tackle box of research gear looking for something else." He finally leashed his rattlesnake by attaching fishing line to it with – bonus points to readers who saw this coming – that icon of invention: duct tape.

Fooling Mother Nature

The core of an experiment in behavioral science depends on changing one thing about an animal's world but leaving everything else the same. This challenge sometimes demands a mix of scientific sophistication and parlor tricks.

Ken Kardong couldn't use a silk handkerchief as a blindfold since the eyes he needed to cover belonged to a rattlesnake. After Kardong's lab at Washington State University in Pullman had documented the biomechanical marvels of the snake's strike, he began thinking that the snake's sensory systems needed to be equally marvelous to take advantage of that natural engineering. He decided to study how the snake's senses contributed to strike targeting, so he wanted to block, and then restore, each of its senses.

Snakes' eyes carry a clear, protective layer that lacks the nerve endings that make human eyeballs so tender. "It's like they're wearing glasses," says Kardong. So, with a conventional snake-handling stick, he held a rattler down on a counter, got a firm grip at the back of its head, and placed a patch of black electrical tape over each eye.

Kardong next had to invent another kind of blindfold, this one for the infrared-sensing pits on the snake's face. Depending on the size of the snake, the pair of pockets varies from depressions the size of a pinhead to pits that could hold a BB.

Again, Kardong thought of electrical tape, but he wanted extra insulation to block heat. At first, he considered rolling up little balls of paper. Then, a brainstorm came from a Styrofoam coffee cup. He sliced it into strips and rolled bits between his thumb and forefinger until he had the right size for each snake.

Kardong says, "My definition of cleverness includes 'simple.'" Blindfolding either the eyes or the pits, by the way, made no difference in the accuracy of a rattlesnake's strike. Sight or heat sensing was sufficient on its own.

Other scientists have also needed to jam and unjam a sensory organ. For instance, Alejandro Purgue invented earmuffs for bullfrogs.

Now at Cornell University's Laboratory of Ornithology in Ithaca, Purgue had been studying the acoustics of North American bullfrogs. He began to suspect that the power of the male's commanding "ribit" came not from the throat but from vibrations in ear membranes. Purgue needed to damp and then release the membranes to document any differences in calls.

He tried smearing globs of standard laboratory silicon grease on the membranes to prevent them from vibrating. However, cleaning grease off the frogs' ears to reverse the effect turned out to be a nuisance. So, Purgue cut little ear pads out of the shock-absorbing foam used for inserts in running shoes. (He bought the foam at a supply company; no shoes were harmed in this experiment.) To link the pads, Purgue wound a tiny, tight coil of piano wire into a spring that would go over the frog's head.

This proved the sticking point of the design. "The angle between their ears was so shallow," says Purgue. "If your head was like that, you'd have trouble keeping your earmuffs on, too." He got a prototype to cover a bullfrog's head just long enough for him to admire the effect. "It just looked adorable," he says.

For the actual experiments, Purgue came up with a better solution: tidy devices that stay in place – the researcher's fingertips.

Purgue's hypothesis indeed proved correct. When he covered the frog's ears, the sound lost its power in midcroak *(Science News: 1/3/98, p. 12)*.

Threat on wheels

Scientific trickery often demands a faux animal, and researchers turn puppeteers. One of the more famous of these stand-ins goes by the name RoboBadger. Its creator, Dan Blumstein of the University of California, Los Angeles, studied alarm calls of marmots and needed something harmless that the rodents would find alarming. Old taxidermy mounts have a long and distinguished history in the study of animal behavior, but the tricky part comes in revealing the stuffed menace to the creatures under study. It's not going to jog into place by itself, so researchers have an equally long and distinguished history of rigging drop cloths on strings to raise the curtain on the pretend threat.

WHAT THE…? A souped-up badger taxidermy mount proves just the thing to provoke calls of alarm from marmots in the wild.
Photograph courtesy of Dan Blumstein (http://www.eeb.ucla.edu/Faculty/Blumstein/)

Blumstein saw a way to render the arrival of his menace, a stuffed badger, a little more realistic. He dismantled a remote control model called Monster Truck and mounted the badger on the wheels and motor. RoboBadger now whirs into view on his own, though Blumstein has to select experimental sites near suitable trails that make good motorized-badger highways.

For a fake aerial predator, Blumstein developed Eagle Knievel, a customized, remote control model glider. "Marmots live in rocky places, and there's never a good place to land a model plane," he sighs. "I've spent days by now gluing him back together."

Lizard specialists like Diana K. Hews take a simpler approach. Based at Indiana State University in Terre Haute, she relies on one animal to provoke specific behaviors from its companions. She attaches a looped string to a fishing pole, lassos a real lizard, and then sets it down where she needs territorial conduct or flirtation. As she stands patiently nearby holding the end of the fishing pole, "they'll display, they'll even mate," Hews says.

Some experimenters fool their subjects with a fake environment rather than a phony or scientist-controlled animal. Paul Switzer of Eastern Illinois University in Charleston was investigating whether male dragonflies were more likely to switch to a new territory after a string of mating setbacks. He had to jinx a dragonfly's love life without changing its style.

"I was working at my aunt and uncle's farm, and they had plenty of sticks and wire," Switzer says. So, he set out sticks good for egg laying in dragonfly territories along a pond edge and attached them to a handle. Switzer lurked nearby until a male started to impress a female prospect with a tour of a stick. Then Switzer dunked the stick out of sight. The male dragonflies seemed to search for it, but in the confusion, the females typically flew away. And yes, sexual discouragement did incline a male to seek new ground.

Details, details

Even after the research designer has worked out the central stage magic for an experiment, dozens of other challenges may loom ahead.

Aaron Krochmal, who grew up in New York City without a lot of personal wildlife experience, recalls that his surprises started when he received the first shipment of his test animals. For his dissertation, he'd devoted months to perfecting a protocol to test rattlesnakes' perception of environmental hiding spots, but he'd never had to manage a live rattler. Disturbingly, his first shipment didn't arrive as he expected, with snakes in a bag, but with each coiled in a 2-pound deli container. Krochmal says, "My first thought was, 'How did they get them in there?' Which was followed rapidly by, 'How am I going to get them out?'"

He'd practiced basic handling routines on nonvenomous snakes, but not extraction methods from deli containers.

To anyone else who should suddenly confront this dilemma, Krochmal, now at Whitman College in Walla Walla, Wash., passes along his solution: Put the snakes in the fridge to chill them to sluggishness. Then, weigh down the top of a container – a length of rebar does nicely – while working loose the seal. With very long-handled clamps, move the container to the snake's new home, turn the container sideways, and gently squeeze.

Just keeping animals of unfamiliar species healthy in the laboratory can bring its own puzzles, says Hews. She recalls one husbandry crisis when she began rearing lots of little lizards in isolation containers. She fed them mutant fruit flies that can't fly, the cuisine that lizards usually enjoyed in her lab. In the solitary containers, though, many of the fruit flies evaded capture by roosting out of reach on the upper walls or outright escaping.

Hews therefore made her containers roost proof by dipping their upper sections in a nonstick coating that comes as a liquid.

Will Mackin of the University of North Carolina at Chapel Hill found a sweet way to measure how deep a bird called a shearwater dives. After finding the serious electronic wizardry that's available to be far too expensive, he came across journal articles describing equipment that costs about a dime. Mackin subsequently updated the technique. In his experiment, he sucked up confectioners' sugar to dust the insides of thin plastic tubes and then used a cigarette lighter to close one end. He attached the tube to a shearwater, and when the bird dove to forage, the increasing pressure drove water into the tube.

When Mackin recovered the tubes, he checked the ring marking the lowest point that water had dissolved the sugar and from that he could calculate the lowest point of the dive. He learned that the birds routinely dive about 7 meters.

FLY BALL. A Ping-Pong ball painted with dots provides a monitor of how a tethered Ormia *fly tracks sounds. Optical sensors picked up the shifting of the dots and sent the information to a computer.*
Photograph courtesy of Andrew Mason.

Andrew Mason also figured out a modern version of old equipment as he monitored an *Ormia* fly's tracking the direction of a sound. Decades ago, German researchers who wanted to monitor the movement of an insect used a globe made for a streetlight. An optical sensor detected when an insect on top of the globe moved off center, and gearing underneath shifted the globe to keep the insect scrabbling on top. That system inspired Mason to paint irregular dots on a Ping-Pong ball and rest it in a modified cradle from an optical computer mouse. When he tethered the fly on top, the optical sensors picked up shifting dots and sent the information directly to a computer.

Who's who?

A basic question in studying social behavior is how to distinguish among the research animals. Even time-tested marking systems, such as colored bands for birds, can turn unexpectedly tricky. The commercial bands don't work on birds such as red-winged blackbirds, says Ken Yasukawa of Beloit College in Wisconsin. The birds fidget with the bands, squeezing them in their beaks until the bands eventually break off.

An idea from a colleague who custom-made bands for smaller birds, sent Yasukawa off to a craft store. He made his birds ankle bracelets, literally, from the plastic beads that melt together into colorful jewelry when pressed with an iron. He cuts a slit in the ring and pries it open just enough to slip it onto a bird's leg.

Yasukawa says a lot of his scientific equipment has come from Kmart, Ace Hardware, and craft stores, and that a good grasp of their offerings enhances creativity in scientific design. "Sometimes, I go just to look around," he says.

Other experimental behaviorists give close consideration to beauty products. Jill Mateo of the University of Chicago says that she's happy with the blue-black Lady Clairol for dyeing individual marks on the Belding's ground squirrels she studies.

Blumstein, however, has switched to a cattle dye for marking wild marmots. It's great, he says – easy to apply and long-lasting. Unfortunately, it dyes researchers' hands, too, a drawback when his field crews go into town for some sociability.

But that's not the most embarrassing social situation an innovative researcher has faced. Consider a string of experiments designed to see whether nonhuman primates have a sense of self. The researchers dyed a few pink streaks on an animal's ear or eyebrow and gave it a mirror. Apes appeared to notice something amiss, but experiments had not found similar reactions in monkeys. Marc Hauser of Harvard University wondered whether somehow changing the dye protocol, using more or different colors, might lead to different results. He asked a student in his lab, whose hair on that day was orange, to recommend a nontoxic dye with lots of colors. "Manic Panic," she told him. The best local source turned out to be Hubba-Hubba, a store that advertises itself as "a boudoir of sin."

When Hauser bought four colors of dye, the clerk asked what he was going to do. He told her that they were for animals but immediately regretted the remark.

Back at the lab, Hauser found that he needed even more colors. When he arrived at Hubba-Hubba the next day, the clerk remembered him. "You were just in here yesterday," she said. "Now, what do you really want?"

To prepare budding young scientists for such eventualities, Steve Nowicki of Duke University in Durham, N.C. starts raising the theme of experimental ingenuity in introductory biology courses. Plenty of concepts abound for great experiments, he tells his students, but they can lie around for decades stalled by some obstacle.

"The idea was there – what you had to do was make it work," he says.